



# ADVANCED SURFACE & NETWORK MANAGEMENT SOLUTIONS

NASA Airline Operations Workshop  
August 2-4, 2016

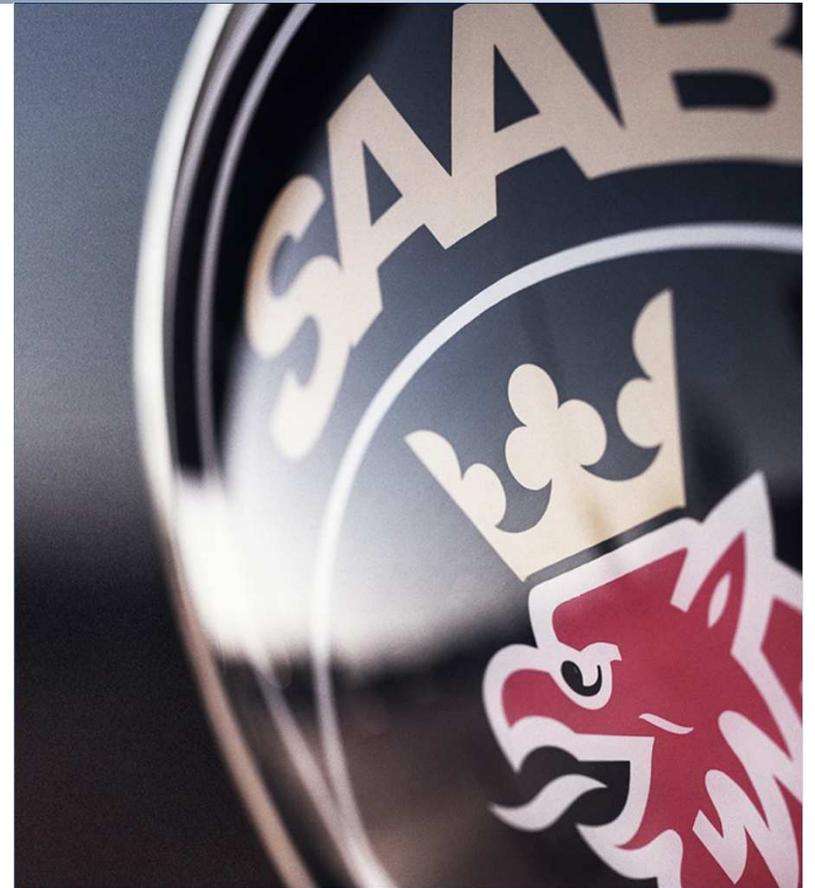


## SAAB SENSIS, WHO WE ARE

- Saab Sensis is a U.S. subsidiary of Saab AB – a global aerospace and defense company founded in Sweden in 1937
- We are headquartered in Syracuse, NY
- We lead Saab’s global ATM unit with solutions deployed at more than 250 locations worldwide

### Mission Statement:

**Enable a safe and efficient aviation system by providing surveillance and automated decision support solutions to all ATM stakeholders**



## OUR AIRLINE FOCUS

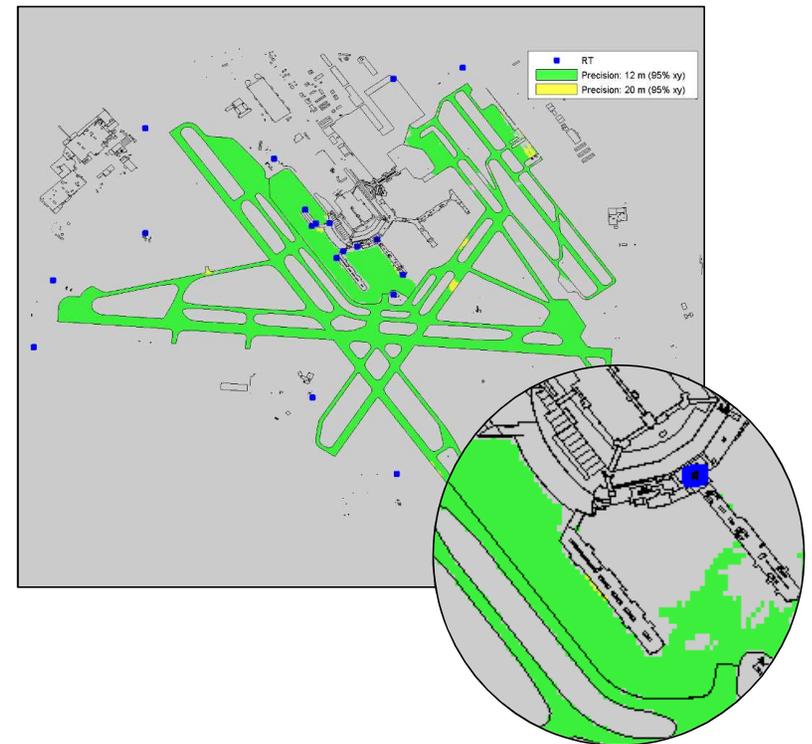


- Since 2003, we have made a concentrated effort to improve airline operations
- We pioneered commercial surface management at DTW with Northwest Airlines
- That first version evolved into the extensive surface and network management suite we offer today
- Our airline solutions primarily include:
  - Surface Surveillance Solutions
  - Aerobahn Suite
  - Digital Ramp Towers



# SURFACE SURVEILLANCE SOLUTIONS

- Managing starts with measuring
- We are the prime contractor on the FAA's ASDE-X and ASSC programs
  - Provide the ATCT with surface surveillance and safety alerts
  - Also help drive commercial solutions, but...
  - Designed to meet FAA needs, not the airlines'
- We offer augmented or independent coverage
  - Mature (7<sup>th</sup> gen) multilateration technology
  - Supports ADS-B
- We also offer cost effective vehicle tracking solutions
  - GPS and LTE for coverage on the entire surface with no upfront infrastructure



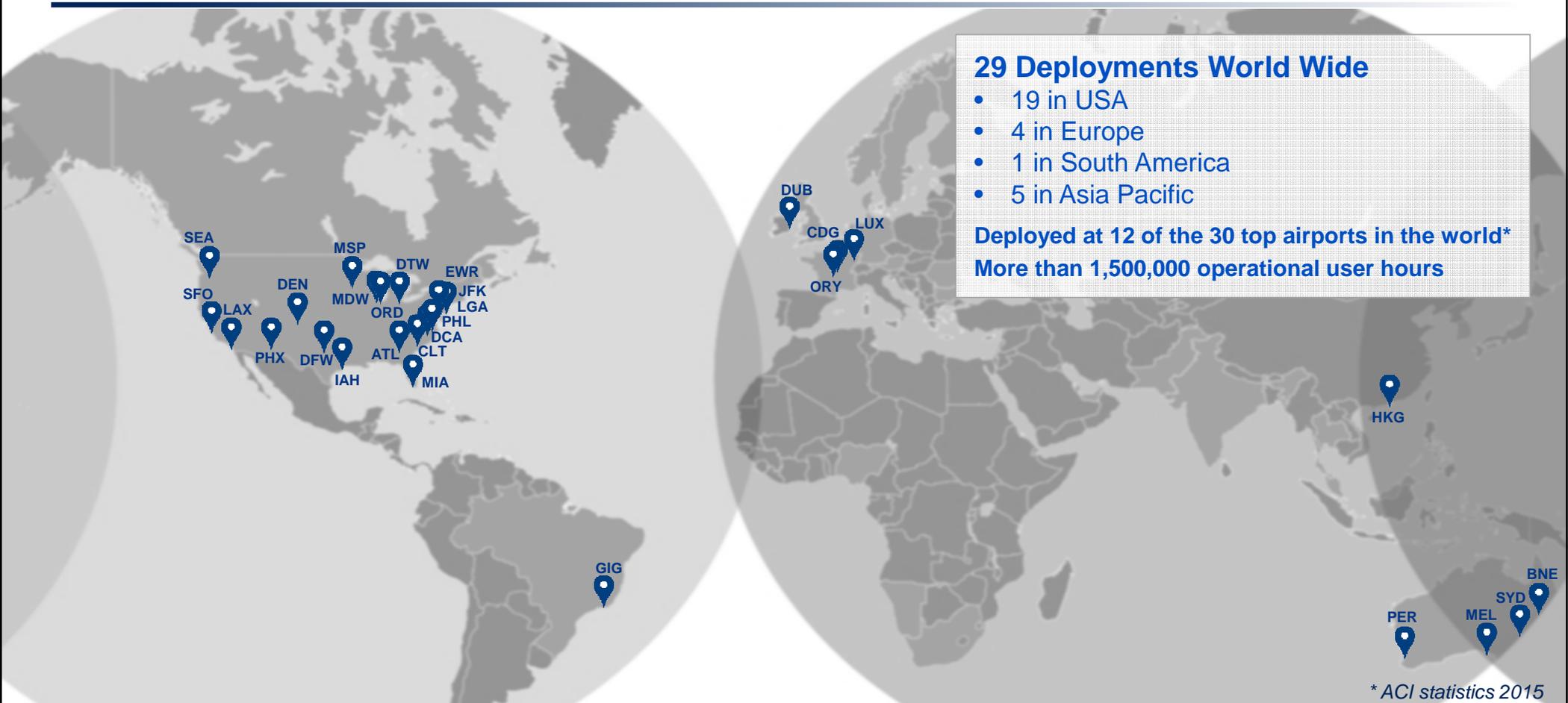
# AEROBAHN SUITE

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## MULTIPLE TOOLS FOR MULTIPLE CHALLENGES



# AEROBAHN DEPLOYMENTS



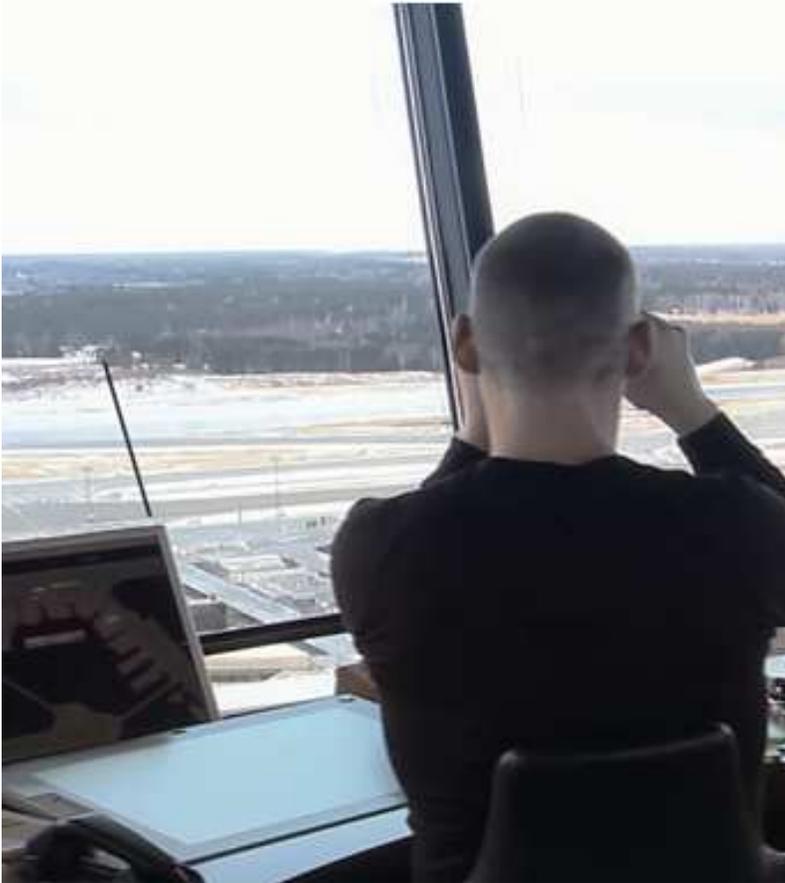
**29 Deployments World Wide**

- 19 in USA
- 4 in Europe
- 1 in South America
- 5 in Asia Pacific

**Deployed at 12 of the 30 top airports in the world\***  
**More than 1,500,000 operational user hours**

\* ACI statistics 2015

# AEROBAHN AIRPORT DASHBOARD



- Shared portal for collecting and distributing performance information
- Centralized location for stakeholders to view key performance indicators (KPIs) and communicate details
- Combines automated metric tracking with user entered bulletins and documents
- Includes information like runway status, construction details, passenger delays, and mass transit status
- Assists in handling irregular operations

# AEROBAHN AIRPORT STATUS DASHBOARD



**Configurable content and layout**

**Automated airport performance metrics**

Arrivals		Today	Last Hour	Next Hour	Departures		Today	Last Hour	Next Hour
Total		137	21	33	Total		173	22	31
On Time		95%	95%	93%	On Time		84%	81%	93%
Average Delay		00:07	00:04	00:04	Average Delay		00:07	00:08	00:25
Average Taxi		00:10	00:10	00:11	Average Taxi		00:15	00:15	00:13
Extended Taxis		1	0	2	Extended Taxis		0	0	0
					Metering Delay		00:05	00:11	00:13
					Compliance		97%	-	-

**User editable bulletins and notes**

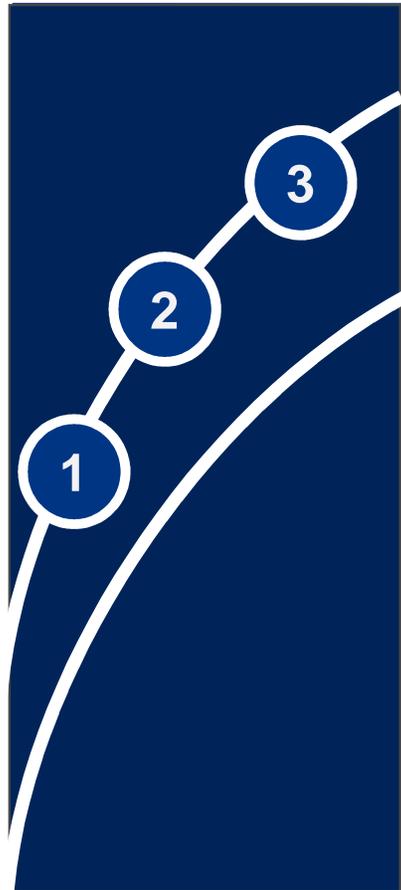
**Document and reference repository**

**Highlights of critical status elements**

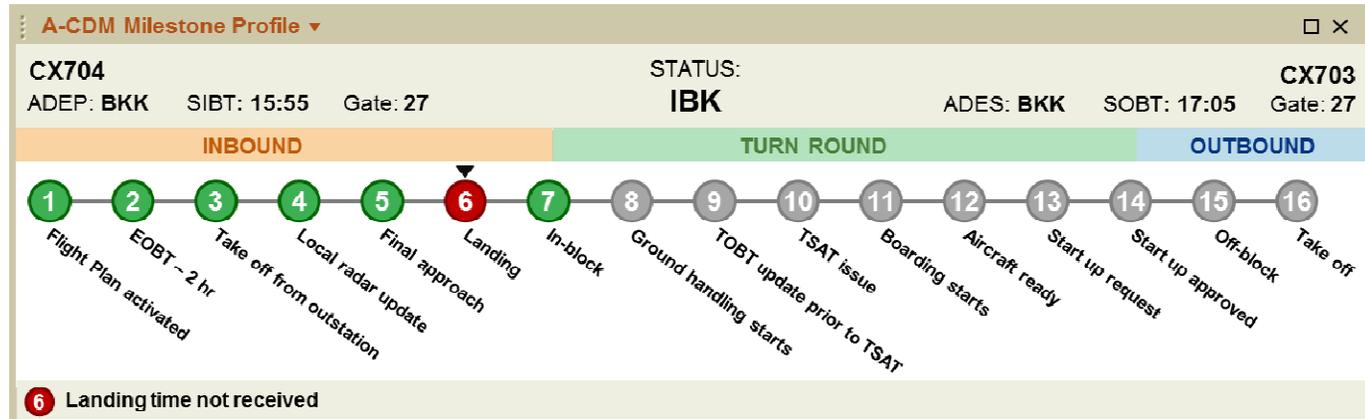
**Status Highlights**

- Airport Operations Status
  - Airport Status is Normal
  - Fueling Operations is Normal
- Irregular Operations
  - General aircraft de-icing is not in effect
- Runway Configuration
  - Departure configuration is 4L
  - Departure configuration change to 13R at 17:00

# AEROBAHN A-CDM MILESTONE MANAGER

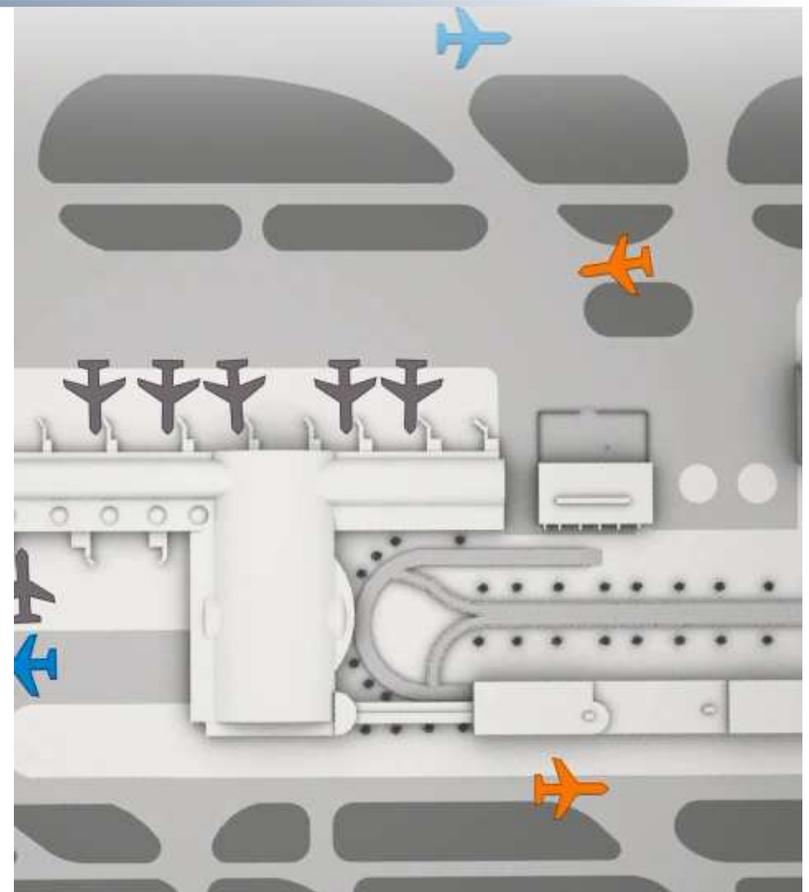


- Foundational component for implementing Eurocontrol-style Airport CDM (A-CDM), which is being adopted at most major non-U.S. airports
- Provides information sharing and milestone tracking capabilities, two of the core conceptual features of A-CDM.
- Links arrival and departure flight information together and incorporates real-time progress updates in accordance with the 16 A-CDM milestones.



# AEROBAHN SURFACE MANAGER

- Wide array of customizable situational awareness tools, both graphical and tabular
- Powerful dynamic rule engine processes fused flight information to expose important operational details
- Condenses huge amounts of data into actionable information and alerts, enabling **management by exception**
- Detailed historical reporting and analytics



# AEROBAHN SURFACE MANAGER

Map display and counters display important flight events and metrics

**Map Display**

Arrivals next 60 min: 26

TX IN Taxi In: 12

LONG IN Taxi in > 10min: 3

Departures DEP next 60 min: 48

TX OUT Taxi Out: 14

LONG OUT Taxi out > 10min: 4

**Business rules provide fully configurable alerts and highlights**

**Departure Statistics**

Departures

Time	Count	Duration (min)
09:15	2.0	1.0
09:30	2.0	1.0
09:45	8.0	2.0
10:00	2.0	1.0
10:15	6.0	1.5
10:30	5.0	1.5
10:45	8.0	2.0
11:00	10.0	2.5
11:15	5.0	1.5
11:30	10.0	2.5

**Airport Demand**

Airport Arrivals (51 Sch, 43 Est) Last Updated 09/11/2015 11:12

Time	Scheduled	Estimated (ATC)	Capacity Threshold
11:30	22	20	20
12:00	11	8	10
12:30	11	10	10
13:00	6	5	10

**Taxi Time**

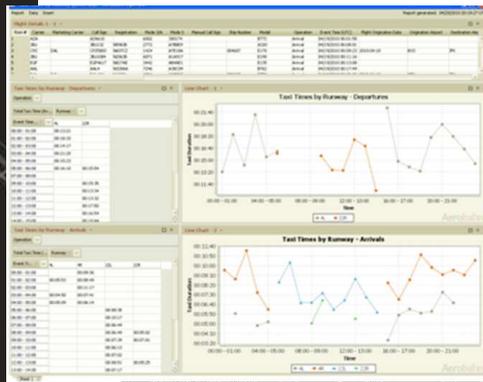
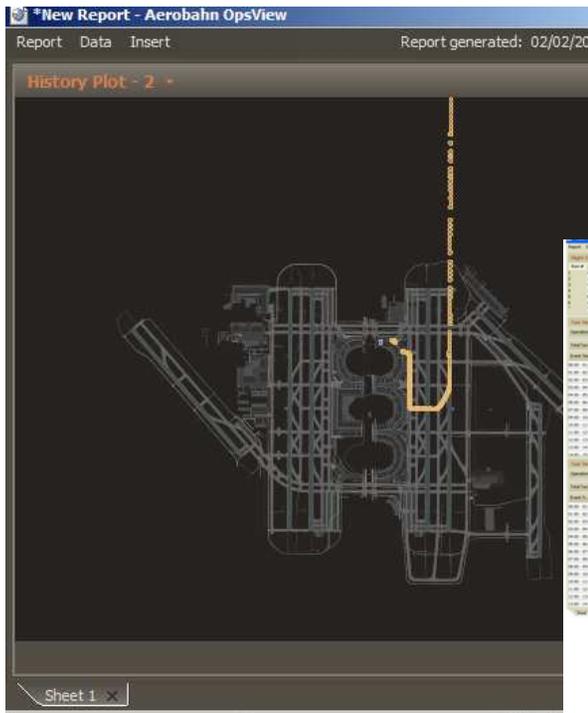
Airport Arrivals (Taxi Completed 10:05 - 11:05): 27

Time	Taxi Time (Aerobahn)	14-Day Avg
00:07:03	00:07:03	00:07:03
00:01:27	00:01:27	00:01:27
00:21:35	00:21:35	00:21:35

40 38 28 N 73 48 40 W [ x = -8346.3 ft y = -470.1 ft d=8359.6 ft ang=266.8 deg ]

Detailed statistical information and forecasts

# AEROBAHN SURFACE MANAGER

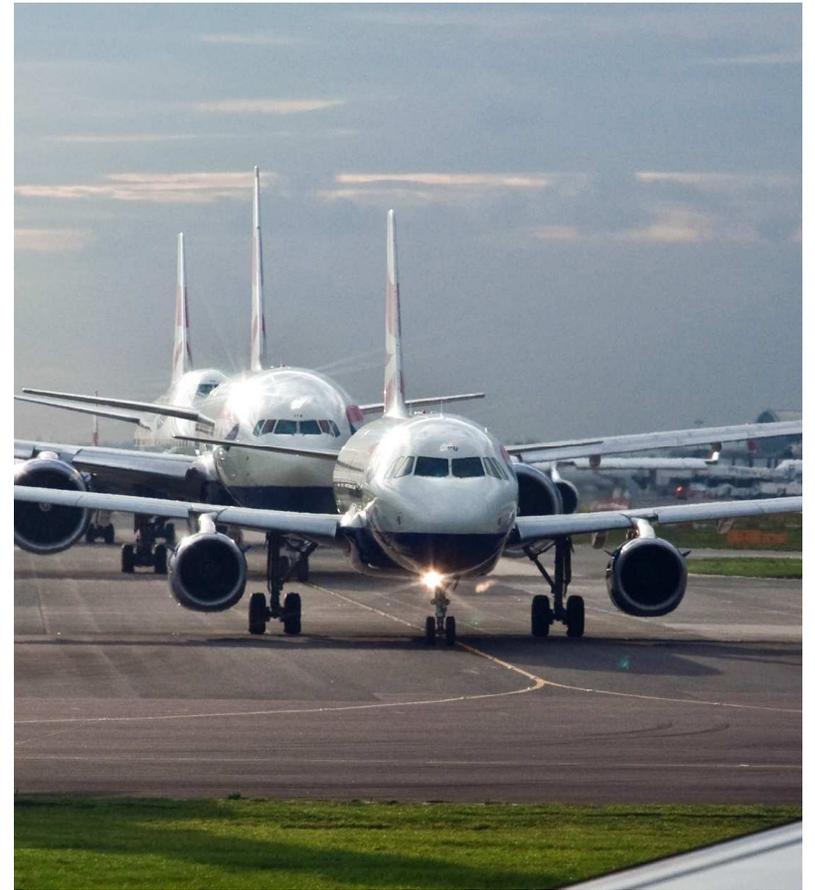


Row Labels	Count of Call Sign	Average of Occupancy Time	Sum of Occupancy Time
12/22/2015	1353	0:00:27	10:00:37
17C	287	0:00:27	2:07:36
TaxiwaySegment_ES_3	41	0:00:08	0:05:36
TaxiwaySegment_ES_4	41	0:00:23	0:15:33
TaxiwaySegment_ES_5	41	0:00:15	0:10:18
TaxiwaySegment_JS_5	41	0:00:36	0:24:26
TaxiwaySegment_JS_6	41	0:00:32	0:22:02
TaxiwaySegment_M_30	41	0:00:30	0:20:21
TaxiwaySegment_M_31	41	0:00:43	0:29:20
17L	1066	0:00:27	7:53:01
TaxiwaySegment_ES_1	133	0:00:15	0:32:51
TaxiwaySegment_ES_2	133	0:00:25	0:56:09
TaxiwaySegment_ES_3	133	0:00:10	0:22:19
TaxiwaySegment_ES_4	134	0:00:20	0:44:51
TaxiwaySegment_ES_5	136	0:00:15	0:33:12
TaxiwaySegment_JS_5	132	0:00:34	1:14:17
TaxiwaySegment_JS_6	132	0:00:32	1:10:24
TaxiwaySegment_P_23	133	0:01:03	2:18:58
12/23/2015	377	0:00:26	2:46:01
17C	176	0:00:28	1:20:41
TaxiwaySegment_ES_3	25	0:00:09	0:03:52
TaxiwaySegment_ES_4	25	0:00:24	0:10:10
TaxiwaySegment_ES_5	26	0:00:15	0:06:40
TaxiwaySegment_JS_5	25	0:00:36	0:15:09
TaxiwaySegment_JS_6	25	0:00:33	0:13:56
TaxiwaySegment_M_30	25	0:00:29	0:12:17
TaxiwaySegment_M_31	25	0:00:45	0:18:37
17L	201	0:00:25	1:25:20
TaxiwaySegment_ES_1	25	0:00:15	0:06:10
TaxiwaySegment_ES_2	25	0:00:25	0:10:18
TaxiwaySegment_ES_3	25	0:00:09	0:03:53
TaxiwaySegment_ES_4	25	0:00:19	0:07:55
TaxiwaySegment_ES_5	25	0:00:15	0:06:10
TaxiwaySegment_JS_5	25	0:00:32	0:13:21
TaxiwaySegment_JS_6	25	0:00:30	0:12:22
TaxiwaySegment_P_23	26	0:00:58	0:25:11

# AEROBAHN DEPARTURE MANAGER

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- Combines pre-departure sequencing and runway sequence optimization
- Enables flight operators to prioritize their own flights
- Incorporates dynamic variable taxi time calculations and trajectory predictions
- Accounts for constraints like wake vortex separation and departure procedure/fix balancing
- Integrated compliance tracking



# AEROBAHN DEPARTURE MANAGER

**Departure management list with per flight Target Start-up Approval Times (TSATs)**

Owner	Flt ID (Aero)	Dest	SOBT (Aero)	EOBT (Aero)	TSAT (Aero)	TOBT (Aero)	TTOT (Aero)	CTOT	First Fix	Gate Asgn	Mtrg Dly
T4	VRD11	SFO	11:30	11:28	11:30	11:36			RBV	Gate_T4_A2	0
T4	BWA10	MBJ	11:15	11:28	11:31	11:37			WAVEY	Gate_T4_A...	16
✖	AA1999	ORD	11:19	11:15	11:33	11:39			COATE	Gate_T8_C...	14
✖	AA1263	LAS	11:30	11:35	11:35	11:41			RBV	Gate_T8_B4	6
✖	AA1245	MCO	11:15	11:09	11:37	11:43			CANDR	Gate_T8_B1	22
JBU	JBU213	LGB	11:29	11:27	11:39	11:45			RBV	Gate_T5_18	10
JBU	JBU1307	IAD	11:41	11:41	11:41	11:47			WHITE	Gate_T5_7	0
FDX	FDX1712	MDT	11:40	11:42	11:42	11:48			RBV		2

**Runway Configuration Tool**

Time	Runway Configuration	Metering Active	Co. Mi. Hold Enabled	Runway	Desired Queue	Planner	Freeze Horizon (bins)	Allocat. Weight (%)
Active	3L	Yes	No	4L	12	32	3	0:100

**Simplified metering coordination**

Status	Group	Requester	Request

# AEROBAHN DE-ICING MANAGER

- Enables scheduling and sequencing of aircraft into centralized de-icing pads to control queues and maximize throughput
- Automatically tracks actual de-icing milestones and durations (queuing, pad occupancy, etc.)
- Facilitates recording of de-icing milestones
- Calculates estimated de-icing queue entry, pad entry, pad occupancy, and pad exit times
- Provides recommended push back and queue entry times to maintain de-icing plan and improve predictability



# AEROBAHN DE-ICING MANAGER

The screenshot displays the Aerobahn De-icing Manager interface for Denver International Airport. The main window is titled 'Aerobahn :: TaxiView :: Denver International Airport'. It features a menu bar (System, Workspace, Settings, Tools, Reporting, Help) and a toolbar with Legend, Playback, Pause, and Search. A status bar at the top indicates 'Region Closure Active : 16L-34R Closed' and 'Mode: Live | 10/04/2013 13:27:15 UTC'.

The interface is divided into several sections:

- Flight Progress:** Shows details for flight FFT674, including Registration (N912FR), Ship Number, AC Type (A319), SOBT (Aero) (13:01), TOBT, ROBT (13:06), DI Pred (De-icing), Pred DI Loc (Man), Pred DI Loc (Aero) (Deice\_WA3), TZQT (13:09), and Est DI Dur (33 min). It also shows 'De-icing Progress' with a time of 00:16:10.
- Usage:** Contains two charts: 'Pad Occupancy' (a Gantt-style chart showing de-icing durations for pads A1-A6 and WA1-WA6) and 'Throughput' (a bar chart showing the number of flights per hour from 1200 to 1600).
- On Pad (7):** A table listing flights currently being de-iced.
 

Act DI Loc	Flt ID (Aero)	Reg	AC Type (...)	AZET	Act DI Dur	EZXT	AZXT
Deice_A1	AAL1208	N849NN	B738	12:47	00:39:33	13:20	
Deice_WA3	FFT674	N912FR	A319	13:09	00:17:34	13:42	
Deice_A2	FFT128	N932FR	A319	13:09	00:17:56	13:42	
Deice_WA2	FFT142	N922FR	A319	13:15	00:11:35	13:48	
Deice_A2	FFT506	N216FR	A320	13:18	00:09:12	13:51	
Deice_A5	FFT726	N941FR	A319	13:10	00:17:08	13:43	
Deice_A5	FFT110	N919FR	A319	13:03	00:23:36	13:36	
- Queued (1):** A table listing flights waiting for de-icing.
 

Flt ID (Aero)	Reg	AC Type (Aer...)	Pred DI Loc (...)	EZET	Est DI Dur (A...	EZXT
FFT440	N928FR	A319	Deice_WA1	13:28	00:33:00	14:01
- Assigned (18):** A table listing flights assigned to de-icing pads.
 

Flt ID (Aero)	AC Type (...)	Gate Act	SOBT (Aer...)	ROBT (Aer...)	Pred DI Lo...	TZQT	EZET	Est
AAL1426	B738		13:35	13:35	Deice_A4	13:38	13:38	00
AAL1246	B752	A53_A53W	13:50	13:50	Deice_WA5...	13:53	13:53	00
FFT765	A320		14:00	14:00	Deice_A4	14:03	14:03	00
FFT261	A319		14:05	14:10	Deice_A3	14:13	14:25	00
FFT847	A320		14:05	14:15	Deice_WA3	14:18	14:30	00
FFT333	A319		14:05	14:16	Deice_WA6	14:19	14:31	00
FFT317	A319		14:05	14:16	Deice_WA5	14:19	14:31	00
FFT557	A319		14:05	14:20	Deice_WA1	14:23	14:35	00
FFT403	A319		14:15	14:26	Deice_WA5	14:29	14:41	00
FFT851	A319		14:10	14:26	Deice_WA4	14:29	14:41	00
FFT653	A319		14:15	14:28	Deice_A1	14:31	14:43	00
- Map Display:** A graphical representation of the taxiway layout with various flight icons and labels such as DAL, SWA270, UAL1187, UAL524, UAL1689, FFT726, FFT110, UAL328, FFT506, AAL1208, FFT000, and FFT440.

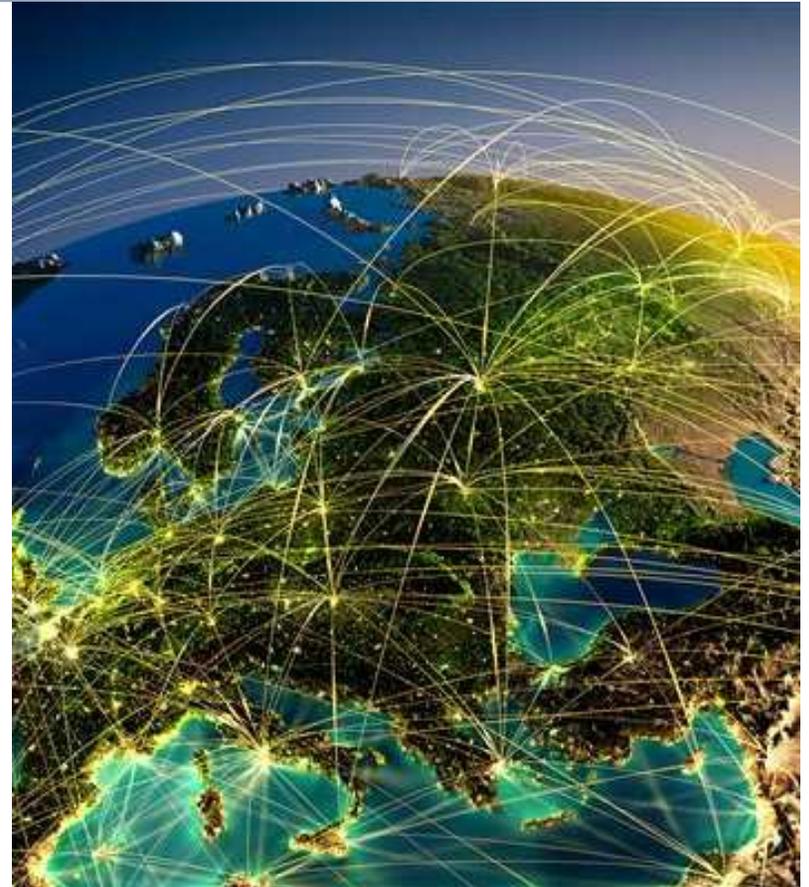
De-icing process is tracked via automated data feeds or manual input

Models de-icing queues and calculates expected throughput and usage

Airlines can prioritize their flights with simple drag-and-drop actions

# AEROBAHN GLOBAL FLIGHT MANAGER

- Easy-to-use decision support tool for the real-time management of a flight network
- Enables monitoring of flights in the en-route, terminal and surface environment
- Tracks flight progress and helps identify, avoid, and manage disruptions like diversions and holds
  - Utilizes our advanced diversion and hold detection algorithms
- Monitor multiple airports and click to zoom on surface situation



# AEROBAHN GLOBAL FLIGHT MANAGER

**Aerobahn Global Flight Manager**

**KCLT**  
CHARLOTTE/DOUGLAS INTL

Diverted From: 7  
Diverted To: 1  
Hold: 4

Favorite Airports: KATL, KCLT, KCOS, KCYS, KDEN, KEWR, KLAS, KLAX, KLGA, KMCO, KMEM, KMIA, KORD, KPHX, KPUB, KSFO, KSTK, KTEB, KTPA

Map Display showing airborne holds

Hold counts: KCLT 4, KDFW 10, KSDF 5, KMCO 10, KJAX 5, KCLT 7, KSAT 3, KMEM 5, KTPA 3, KDFW 2, KFLL 3, KOAK 2, KIAH 3

Flight drill-down: AAL148

Hold Stack information:

Hold	From	To
4	KCLT	KDFW
10	KDFW	KSDF
5	KSDF	KJAX
10	KMCO	KJAX
5	KJAX	KSAT
7	KCLT	KSAT
3	KSAT	KTPA
5	KMEM	KTPA
3	KTPA	KFLL
2	KDFW	KFLL
3	KFLL	KIAH
2	KOAK	KIAH

Holding Stacks:

Hold	From	To
2	MURPH	30°/90nmi
25,000	AAL148	00:08:55
26,000	AAL1709	00:06:38
1	VEERS	25°/90nmi
24,000	AAL1780	00:09:49

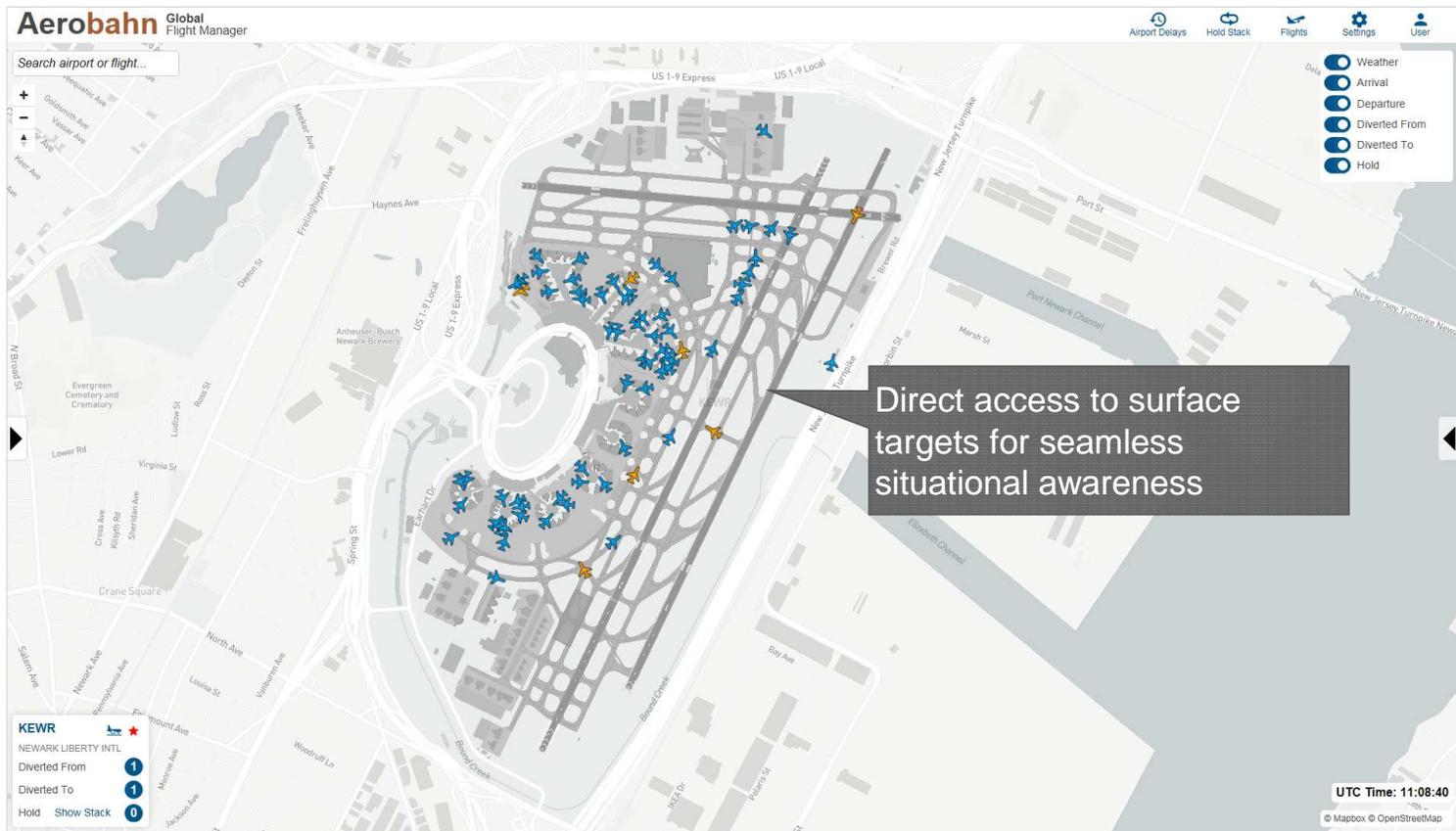
Detailed flight information for all holds:

Flight Id	Origin	Hold L...	Range...	Duration	Altitud...	SIBT
AAL148	KJFK	MURPH	104	00:08:55	25,000	12:12
AAL1780	KBDL	VEERS	107	00:09:49	24,000	12:06
AAL1709	KBOS	MURPH	119	00:06:38	26,000	12:07
JIA5327	KIAD		187	00:05:36	26,000	12:27

Flight details for AAL148:

Origin: KJFK  
Arrival Fix: LYH  
Hold Location: MURPH  
Range (nm): 104  
Altitude (ft): 25,000  
Hold Duration: 00:08:56  
ATOT: 10:40  
STOT: 10:51  
SLDT: 12:12  
ELDT: 11:57

# AEROBAHN GLOBAL FLIGHT MANAGER



## AEROBAHN SUCCESS STORY: JFK



- At JFK, airlines and the Port Authority of NY and NJ are achieving significant taxi time reductions and cost savings with Aerobahn
- The Aerobahn Departure Manager is used daily to optimize the departure process
- During busy periods, all departures are assigned a metering time to limit runway queues
- Average of \$15.6 million per year in fuel savings, combined with a reduction of 32,000 metric tons of CO2 emissions
- The airport is making better use of its resources and providing a better experience for passengers traveling through JFK
- And the FAA is provided a better sequence of aircraft in order to optimize runway usage and throughput

## AEROBAHN SUCCESS STORY: PHX



- In Phoenix, Aerobahn is the foundation of a joint project between airlines, the FAA, and the City of Phoenix
- It is used to optimize the arrival traffic flow during peak periods
- The results:
  - During major banks, taxi times have been reduced by ~5 minutes per flight
  - Overall arrival taxi times are down about a ½ minute per flight
  - There's an ~50% reduction in the number of communications between pilot and ground
  - Transmission counts have decreased by over 252 transmissions/day (59%).
  - Ramp controller time has decreased by 9.25 minutes/day (17%).

# PHX OPERATIONAL SOLUTION

## FAA Ground



~~What Gate?~~  
~~Gate Status?~~  
Hold in Penalty Box!  
Proceed to Spot!

## Pilot/Co-Pilot



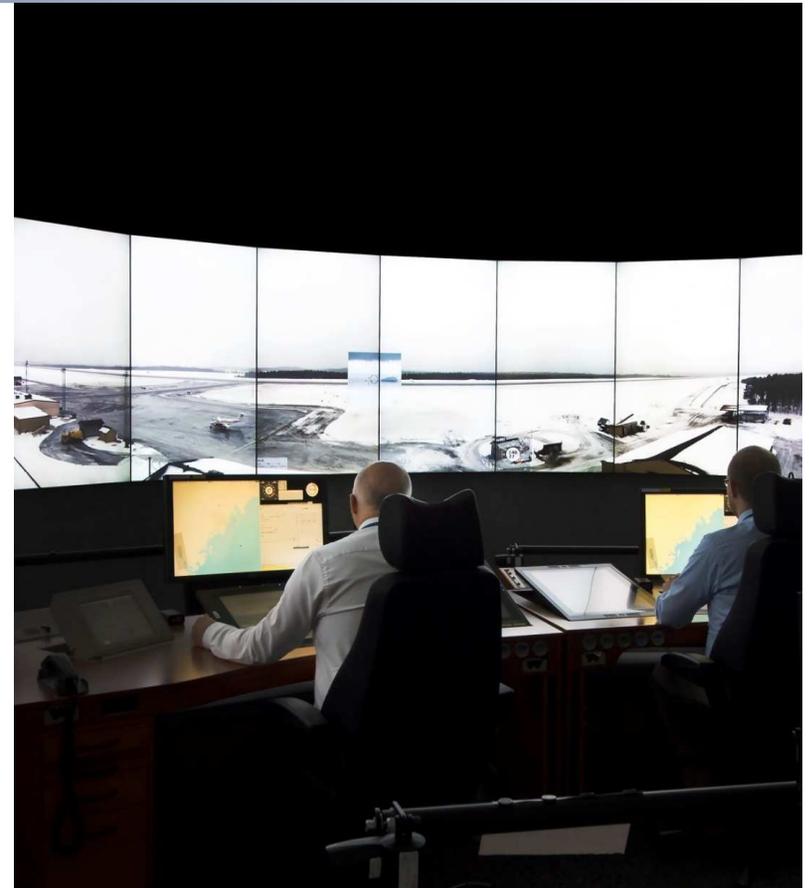
~~What Gate?~~  
~~Gate Status?~~  
~~Ramp Ready?~~  
Ramp ready to accept!

## Ramp Control

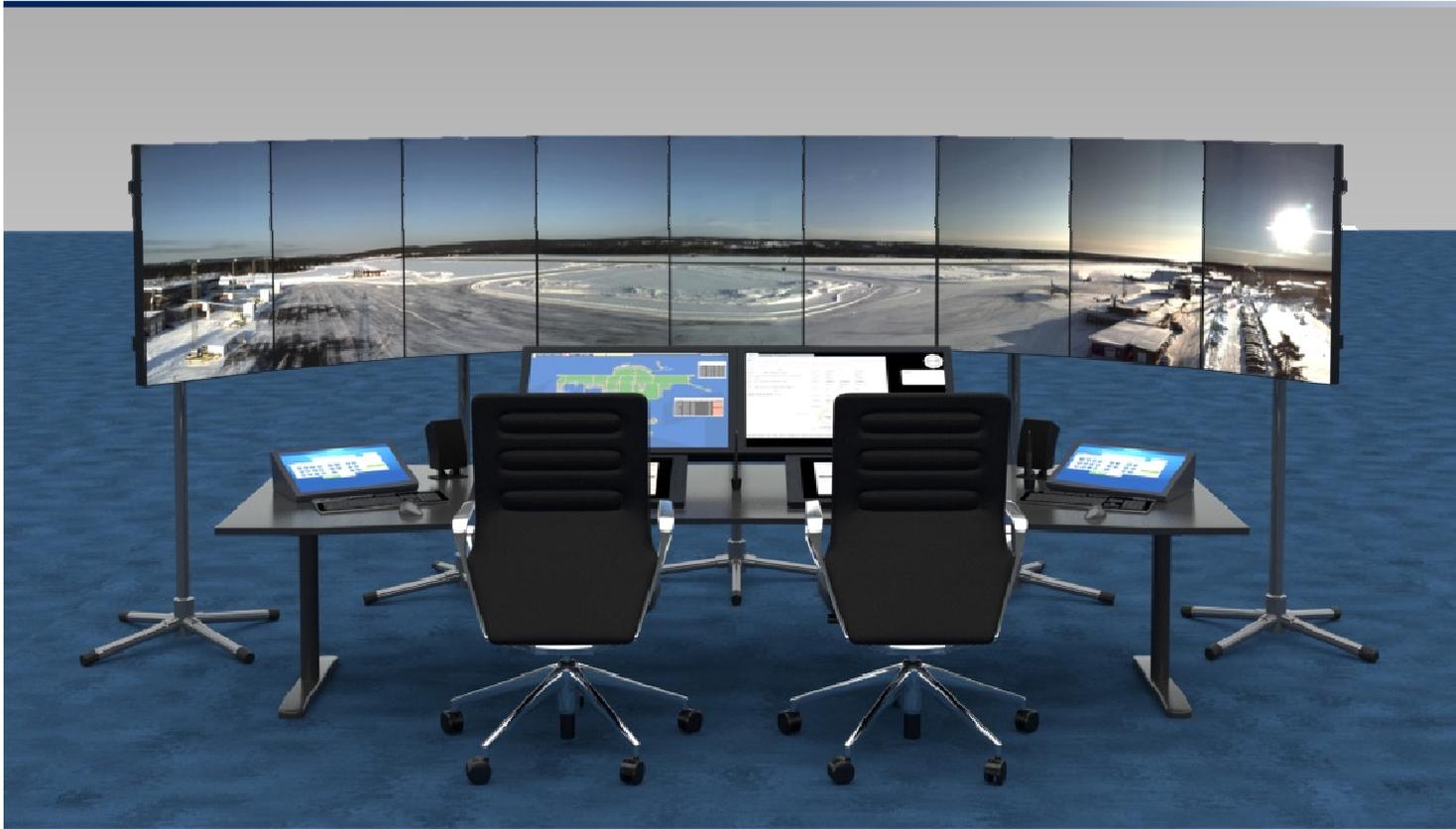


# DIGITAL TOWER SOLUTIONS

- Our Digital Tower Solutions enable ATC and ramp control services to be provided more efficiently **for any airport, from any location**
- Instead of a traditional tower, a lower-cost array of cameras is deployed
- An enhanced “out of the window” view is sent over a digital network
- Controllers are provided with an advanced working position and perform their duties as if they were in a physical tower



# A NEW APPROACH TO ATC AND RAMP CONTROL





# ADVANCED SURFACE & NETWORK MANAGEMENT SOLUTIONS

NASA Airline Operations Workshop  
August 2-4, 2016

